NOνA Database Table Schemes

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1 Introduction

Data written to and read from the database will be done by certain "groups". These groups fall into three categories: hardware, online and offline. Hardware groups include those responsible for the PVC extrusions, detector readout electronics and the blended scintillator. Online groups include the DAQ and DCS systems. Finally, offline groups include the calibration, beam systematics and analysis groups. A general overview of the relationships between the various tables from these groups is shown in Fig. 1.

At the moment, we have tables defined for the Scintillator, DAQ, PVC extrusion and Assembly groups. This document will outline the schemes of the various tables in the NOνA database.

2 Hardware Database Tables

2.1 NOνA Liquid Scintillator

The NOνA liquid scintillator will be composed of mineral oil, pseudocumene, PPO, bis-MSB and Stadis-425. Mineral oil is the solvent, and pseudocumene is the primary scintillant. PPO and bis-MSB are waveshifters. Stadis-425 is an agent to prevent static discharge. Table 1 lists the type and mass fraction of each component of the scintillator.

For each of these components, we will want to keep track of the factory location, date/time shipped from factory, destination location, date/time received at location, and as-yet unspecified data from the material data sheet. Furthermore, various quality control (QC) tests will be made for each component and the final product (blended scintillator). As part of the QC tests for the mineral oil and the blended scintillator, the attenuation length will be measured as a function of wavelength. These measurements will also be stored in the database. Tables 2-6 give details on the structure of the database tables for the NOνA scintillator and components.

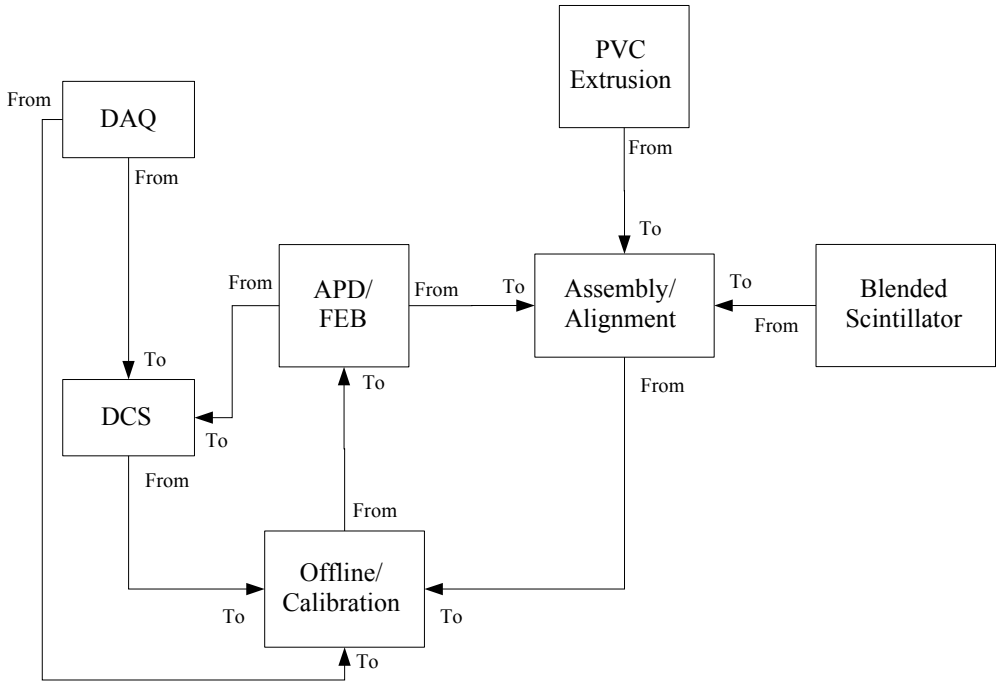

Figure 1: General overview of the relationship between the various tables in the NOνA database.

Component	Type	Mass Fraction (%)
Mineral Oil	liquid	94.4
Pseudocumene	liquid	5.5
PPO	powder	0.1
bis-MSB	powder	0.002
Stadis-425 (anti-static)	liquid	0.0002
Total		100

Table 1: Some properties of the components of the NOνA liquid scintillator.

Mineral Oil dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Factory	string	
Date/Time Shipped	timestamp	
Destination	string	
Date/Time Received	timestamp	Must be $>$ Shipped date
Density	float	
Water Content	float	
Number of Atten. Length Measurements	int	
Atten. Length id	int	
Comment	string?	
username	string	

Table 2: Mineral Oil database table.

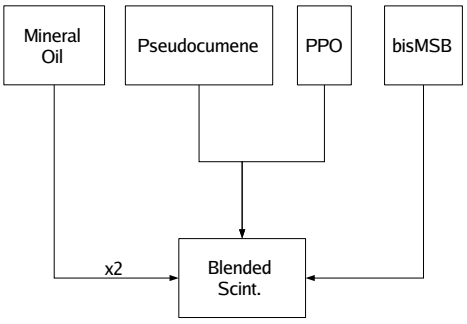

Figure 2: Schematic of the Scintillator database tables. The blended liquid scintillator here is assumed to be composed of no more than two batches of mineral oil, and only one batch of pseudocumene, PPO and bisMSB.

Pseudocumene dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Lot Number	string	
Cas Number	string	
Factory	string	
Date/Time Shipped	timestamp	
Destination	string	
Date/Time Received	timestamp	Must be $>$ Shipped date
Volume	float	
Pseudocumene	float	range between 0. and 1.
trimethyl benzene1	float	range between 0. and 1.
trimethyl benzene2	float	range between 0. and 1.
2 methylpropyl benzene	float	range between 0. and 1.
1 methylpropyl benzene	float	range between 0. and 1.
1 methy x	float	range between 0. and 1.
1 methylethyl benzene		
trimethyl benzene3	float	range between 0. and 1.
indane	float	range between 0. and 1.
impurity	float	range between 0. and 1.
clarity	float	range between 0. and 1.
Comment	string?	
username	string	

Table 3: Pseudocumene database table.

PPO dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Lot Number	string	
Cas Number	string	
Factory	string	
Date/Time Shipped	timestamp	
Destination	string	
Date/Time Received	timestamp	Must be $>$ Shipped date
Melting Point	float	$71^{\circ}C <= T <= 73^{\circ}C$
Appearance	string?	pass/fail, should be white powder
Odor	string	should be odorless
Transmission (1 cm path length at 370 nm)	float	$0.85 < T < 1.$
Transmission (10 cm path length at 370 nm)	float	$0.60 < T < 1.$
Fluorescence/320 nm FS excitation	float	
Proton NMR	string?	pass/fail
Infrared Spectroscopy	string?	pass/fail
Comment	string?	
username	string	

Table 4: PPO database table.

bisMSB dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Lot Number	string	
Cas Number	string	
Factory	string	
Date/Time Shipped	timestamp	
Destination	string	
Date/Time Received	timestamp	Must be $>$ Shipped date
Melting Point	float	$179^{\circ}C <= T <= 182^{\circ}C$
Appearance	string?	pass/fail, should be yellow crystalline powder
Odor	string	should be odorless
Transmission (1 cm path length at 370 nm)	float	$0.90 < T < 1.$
Transmission (10 cm path length at 370 nm)	float	$0.80 < T < 1.$
Fluorescence/320 nm FS excitation	float	
Proton NMR	string?	pass/fail
Infrared Spectroscopy	string?	pass/fail
Comment	string?	
username	string	

Table 5: bisMSB database table.

Blended Scintillator dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Factory	string	
Date/Time Shipped	timestamp	
Destination	string	
Date/Time Received	timestamp	Must be $>$ Shipped date
Number of Atten. Length Measurements	int	
Atten. Length id	int	
Comment	string?	
username	string	

Table 6: Blended Scintillator database table.

Attenuation Length Data Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
wavelength	float	
atten. length	float	
atten. length uncertainty	float	

Table 7: Attenuation length data table.

We expect that there will be a many-to-one relationship between the mineral oil table and the blended scintillator table (that is, we expect that more than one batch of blended scintillator to be made from a single batch of mineral oil). However, we also want to allow for the possibility that a batch of blended scintillator could be made from up to two different batches of mineral oil. Fig. 2 shows the relationship between the blended scintillator table and the components' tables.

2.2 PVC Extrusions

PVC Extrusion dB Table		
Column Name	**Variable Type**	**Comments**
id	string?	primary key
PVC resin box number	integer	
PVC resin lot number	integer	
Reflectivity Visual Inspection	pass/fail	
Reflectivity Measurement (center)	float[2]	
Reflectivity Measurement (far end)	float[2]	
Reflectivity Measurement (near end)	float[2]	
Web thickness	float[15]	
Top wall thickness	float[15]	
Bottom wall thickness	float[15]	
Left wall thickness	float	
Right wall thickness	float	
Flatness (center)	float	
Flatness (far end)	float	
Flatness (near end)	float	
Width (center)	float	
Width (far end)	float	
Width (near end)	float	
Mean Width	float	
Sigma Width	float	
Height (center)	float	
Height (far end)	float	
Height (near end)	float	
Mean Height	float[16]	
Sigma Height	float[16]	
Weight	float	
End-piece pressure test	pass/fail	
Physical location	string	
Comment	string?	
username	string	

Table 8: PVC extrusion database table.

PVC Daily Extrusion Tests		
Column Name	**Variable Type**	**Comments**
id	string?	primary key
Day	date	
Type	horizontal/vertical	
Density	float	
Pressure-to-failure test	pass/fail	
Young's modulus	float	
Yield point	float	
Ultimate stress	float	
Drop dart result	float	
Reflectivity	float[10]	
Light yield	float	
Comment	string?	
username	string	

Table 9: Daily PVC tests.

2.3 Assembly Group

The Assembly Group is responsible for mounting the 32-cell PVC modules constructed by the PVC group in the NOvA detectors. Therefore

Assembly Table		
Column Name	**Variable Type**	**Comments**
id	string?	primary key
PVC Module id	string	foreign key
Date installed	date	
installer	string	
Shipment number	string	
Accepted	yes/no	
Leak rate	float	
Fiber continuity test	pass/fail	
Block number	int	
Plane number	int	
Module number within plane	int	
Number of survey targets	int	
First survey target id	int	foreign key
Upstream adhesive batch id	string	
Downstream adhesive batch id	string	
Number of scintillator fills	int (1 or 2)	
Fill date 1	date	
Scint. batch 1 id	int	
Scint. batch 1 volume	float	
Scint. batch 1 temperature	float	
Fill date 2	date	
Scint. batch 2 id	int	
Scint. batch 2 volume	float	
Scint. batch 2 temperature	float	
Comment	string?	
username	string	

Table 10: Detector PVC module assembly table.

Survey Target Table		
Column Name	**Variable Type**	**Comments**
id	string?	primary key
x position	float	
x position uncertainty	float	
y position	float	
y position uncertainty	float	
z position	float	
z position uncertainty	float	
Comment	string?	
username	string	

Table 11: Assembly survey target data table. Each entry represents a measurement from a single survey target, that is, (x,y,z) positions.

DAQ DCM dB Table		
Column Name	**Variable Type**	**Comments**
SN	string?	primary key
Ethernet MAC Address	string	
Ethernet IP Address	string	
Operating System Version	string	
Operating System Version Installation Date	timestamp	
Application Software Version	string	
Application Software Version Installation Date	timestamp	
FPGA Firmware Version	string	
FPGA Firmware Version Installation Date	timestamp	
CPLD Firmware Version	string	
CPLD Firmware Version Installation Date	timestamp	
PC Board Version	string	
PC Board Revision	integer	
Physical location	string	
Comment	string?	
username	string	

Table 12: DAQ Data Concentrator Module database table.

2.4 Data Acquisition System

Data Acquisition System hardware consists of data concentrator modules (DCMs), switches and nodes.

DAQ Switch dB Table		
Column Name	**Variable Type**	**Comments**
SN	string?	primary key
Module Brand	string	
Module Model Number	string	
Module Version Number	string	
Firmware Version Number	string	
Physical location	string	
Comment	string?	
username	string	

Table 13: DAQ Switch database table.

DAQ Buffer Node dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Node Number	integet	
Commission Date	timestamp	
Decommission Date	timestamp	
Ethernet MAC Address	string	
Ethernet IP Address	string	
Operating System Version	string	
Operating System Version Installation Date	timestamp	
Application Software Version	string	
Application Software Version Installation Date	timestamp	
CPU Count	integer	
Total Memory	integer	
Replacement Component Type		Not sure what this is
Replacement Component Date		Not sure what this is
Replacement Component ID		Not sure what this is
Comment	string?	
username	string	

Table 14: DAQ Buffer Node database table.

DAQ DCM Monitoring dB Table		
Column Name	**Variable Type**	**Comments**
DCM id	integer	
Time	timestamp	
CPU Load	integer	
Memory Usage	integer	
Receive Packets	integer	
Receive Errors	integer	
Receive Packets Dropped	integer	
Transmit Packets	integer	
Transmit Errors	integer	
Transmit packets Dropped	integer	

Table 15: DAQ DCM Monitoring database table. Primary key would be a combination of DCM id and timestamp?

3 Online Database Tables

3.1 Detector Controls System

3.2 Data Acquisition System

The relationship between the various tables for the DAQ system is described in the ER diagram in Fig. 3.

3.2.1 Transient DAQ Monitoring Tables

Monitoring database (transient for N months, where N is initially assumed 3 months), entries added once per minute (could be faster or slower).

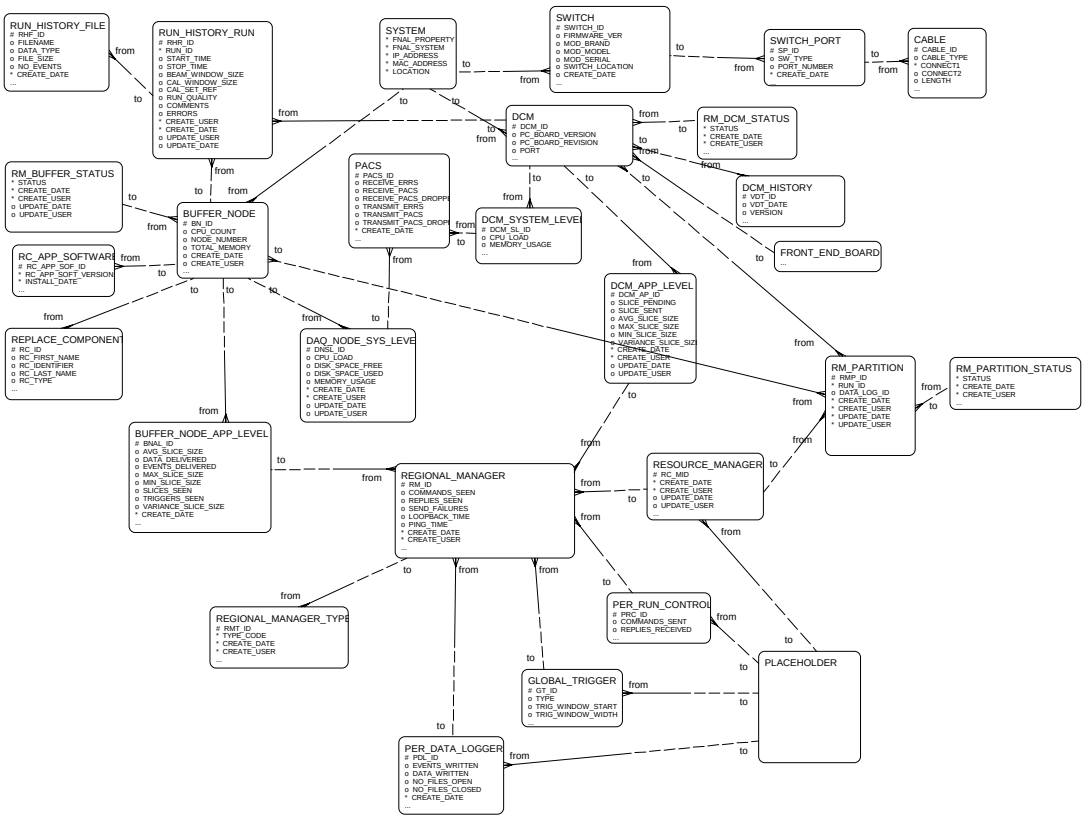

Figure 3: ER diagram for NOvA DAQ tables. Note that there are relationships between the DAQ hardware and the DAQ online tables.

DAQ Node Monitoring dB Table		
Column Name	**Variable Type**	**Comments**
DCM id	integer	
Time	timestamp	
CPU Load	integer	
Memory Usage	integer	
Receive Packets	integer	
Receive Errors	integer	
Receive Packets Dropped	integer	
Transmit Packets	integer	
Transmit Errors	integer	
Transmit packets Dropped	integer	
Disk Space Used	float	
Disk Space Free	float	

Table 16: DAQ Node Monitoring database table. Primary key would be a combination of DCM id and timestamp?

DAQ DCM Application Monitoring dB Table		
Column Name	**Variable Type**	**Comments**
DCM id	integer	
Time	timestamp	
Slices Pending	integer	
Slices Sent	integer	
Average Slice Data Size	integer	
Minimum Slice Data Size	integer	
Maximum Slice Data Size	integer	
Variance Slice Data Size	integer	
Regional Manager Ping Time	integer	
Regional Manager Loopback Time	integer	

Table 17: DAQ DCM Application Monitoring database table. Primary key would be a combination of DCM id and timestamp?

DAQ Node Application Monitoring dB Table		
Column Name	**Variable Type**	**Comments**
Node id	integer	
Time	timestamp	
Slices Seen	integer	
Average Slice Data Size	integer	
Minimum Slice Data Size	integer	
Maximum Slice Data Size	integer	
Variance Slice Data Size	integer	
Triggers Seen	integer	
Events Delivered	integer	
Data Delivered	integer	
Regional Manager Ping Time	integer	
Regional Manager Loopback Time	integer	

Table 18: DAQ Node Application Monitoring database table. Primary key would be a combination of DCM id and timestamp?

DAQ Data Logger Monitoring dB Table		
Column Name	**Variable Type**	**Comments**
Node id	integer	
Time	timestamp	
Events Written	integer	
Data Written	integer	
Number Files Open	integer	
Number Files Closed	integer	
Regional Manager Ping Time	integer	
Regional Manager Loopback Time	integer	

Table 19: DAQ Data Logger Monitoring database table. Primary key would be a combination of id and timestamp?

DAQ Global Trigger Monitoring dB Table		
Column Name	**Variable Type**	**Comments**
Trigger id	integer	
Time	timestamp	
Regional Manager Ping Time	integer	
Regional Manager Loopback Time	integer	

Table 20: DAQ Global Trigger Monitoring database table. Primary key would be a combination of id and timestamp?

DAQ Run Control Monitoring dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Time	timestamp	
Regional Manager Ping Time	integer	
Regional Manager Loopback Time	integer	
Commands Sent	integer	
Replies Received	integer	

Table 21: DAQ Run Control Monitoring database table.

DAQ Resource Manager Monitoring dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Time	timestamp	
Regional Manager Ping Time	integer	
Regional Manager Loopback Time	integer	

Table 22: DAQ Resource Manager Monitoring database table.

DAQ RegionalManager Monitoring dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Time	timestamp	
Commands Seen	integer	
Replies Seen	integer	
Send Failures	integer	

Table 23: DAQ Regional Manager Monitoring database table.

DAQ Global Trigger dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
Type	integer	Calibration or Beam
Window Start	integer	
Window Width	integer	

Table 24: DAQ Global Trigger database table. This will be filled approximately every 2 seconds.

DAQ DCM Resource Management dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
List of DCMs	N integer	
Status of DCMs (good/bad/debug)		
List of DCMs	M integer	
List of Buffers	M integer	
Status of Buffers	M integer	
List of Data Loggers	? integer	

Table 25: DAQ DCM Resource Management database table.

3.2.2 DAQ Resource and Configuration Tables

Configuration would be tables that map what hardware is defined for a given run that could be linked from the run history database or just included in there. Resource is dynamic and shows what hardware is currently allocated to a partition and which partition that is.

DAQ Partition Resource Management dB Table		
Column Name	**Variable Type**	**Comments**
id	integer	primary key
List of DCMs	N integer	
List of Buffer Nodes	M integer	
Run Control ID	integer	
Data Logger ID	integer	

Table 26: DAQ Partition Resource Management database table.

DAQ Run History dB Table		
Column Name	**Variable Type**	**Comments**
Run Number	integer	
Start time	timestamp	
Stop time	timestamp	
Beam Window Size	integer	
Calibration Window Size	integer	
DCBs in Run	N integer (variable)	
Buffer Farm Nodes	M integer	
Calibration id	integer	
Run Quality	integer	
Comments	string	
Username	string	
Errors	X integer	

Table 27: DAQ Run History database table.

DAQ SubRun History dB Table		
Column Name	**Variable Type**	**Comments**
SubRun Number	integer	
Run Number	integer	
Data type	integer	
First Event Start time	timestamp	
Last Event Stop time	timestamp	
File size		
Number of Events		

Table 28: DAQ Subrun History database table.